Exhibit A

Polster, Lieder, Woodruff & Lucchesi, L.C.
Patent ■ Trademark ■ Copyright ■ Trade Secret ■ Unfair Competition

12412 Powerscourt Drive, Suite 200
St. Louis, Missouri 63131-3615
TELEPHONE: 314.238.2400
FACSIMILE: 314.238.2401
E-MAIL: plwl@patpro.com

Nelson D. Nolte
E-Mail: nnolte@patpro.com
http://www.patpro.com

March 14, 2005

VIA USPS EXPRESS MAIL & E-mail

Seth Harbuck
104 Carrollton Ave.
Shreveport, LA 71105

Re: Patent Application for LOW COST FUEL PUMP AND FILTER ASSEMBLY
Our File: PCRC 8472U1

Dear Mr. Harbuck:

We represent PC/RC Products, L.L.C. in intellectual property matters.

The U.S. Patent & Trademark Office requires inventors to sign declarations in the form of the enclosed declaration before examination of inventions. In that regard, we ask that you read the enclosed patent application for the invention that you previously assigned to PC/RC Products. After reading the application, we ask that you read the declaration, sign it and return it to us in the enclosed self-addressed, stamped envelope.

So that we may respond to the Patent & Trademark Office in a timely fashion, we ask that you do so within the next two weeks. If you have any questions, please give me a call.

Sincerely,

Nelson Nolte

Enclosures
NDN/asn

EV613449942US

cc: Jim Bellistri
cc: Lionel L. Lucchesi, Esq.

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that: My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled LOW COST FUEL PUMP AND FILTER ASSEMBLY, the specification of which

☐ is attached hereto.
☒ was filed on September 23, 2003
☐ and was amended on as United States App. No. or PCT International App. No. (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
			[☐] yes [☐] no
			[☐] yes [☐] no

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States Provisional Application(s) listed below:

Application Number	Filing Date
60/412,892	September 23, 2002

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below:

_____	_____	_____
(Application No.)	(Filing Date)	(Status - patented, pending, abandoned)
_____	_____	_____
(Application No.)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of First Inventor: E. Seth Harbuck

Inventor's Signature: _____ Date: _____
Residence: City of Shreveport, State of Louisiana
Citizenship: USA
Post Office Address: 104 Carrollton Avenue, Shereveport, LA 71105

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SPECIFICATION

To All Whom It May Concern:

Be it known that I, E. Seth Harbuck, a citizen of the United States and a resident of the State of Louisiana, whose post office address is 104 Carrollton Avenue, Shreveport, LA 71105, have invented new and useful improvements in a

LOW COST FUEL PUMP AND FILTER ASSEMBLY

EXPRESS MAIL NO: EV 255300040US

CROSS REFERENCE TO RELATED APPLICATIONS NOT IN BACKGROUND OF INVENTION.

This application is related to United States Provisional Patent Application No. 60/412,892 filed September 23, 2002 from which priority is claimed.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND OF THE INVENTION

This invention relates to a fuel pump and filter assembly found, and in a fuel delivery system for, small internal combustion engines, in particular, two stroke and four stroke engines.

Among a variety of factors driving the development of small internal combustion engines by manufacturers, are consumer demands for more powerful and more environmentally friendly engines, as well as regulations pertaining to the use and operation of these engines. Conjoined with these factors is a need to build a product that is cost-effective in reducing emissions and supplying power.

One solution to these problems is fuel injection. Fuel injection for small internal combustion engines has many potential advantages, among them being reduced fuel emissions. However, fuel injection typically increases costs. In order to provide fuel injection to small engines, in particular two and four cycle engines, components must be reduced in size and simplified in order to be considered practical for implementation in the engine design.

The United States Patent to Hajj, et al. No. 6,343,596 ('596) describes a fuel injection system for small engines, which provides a microprocessor-based system for operating a fuel regulatory valve. The specification of the '596 patent is incorporated herein by reference as if fully stated. While the fuel pump of the present invention is intended to operate in conjunction with a system similar to the system described in the '596 Patent, the present invention also provides an improved fuel regulator over that described in the '596 specification. The present invention is microprocessor controlled and is intended to operate at frequencies of between 30-50 hertz. The small size of the fuel pump is an important consideration in the engine type for which the invention of the '596 patent and the present fuel pump finds application.

BRIEF SUMMARY OF THE INVENTION

One of the objects of this invention is to provide a low cost fuel pump.

Another object of this invention is to provide a fuel pump that is adaptable to the operation of two and four cycle internal combustion engines.

Another object of this invention is to provide a fuel pump construction that permits an excitation coil to be easily mounted on the pump body.

Yet another object of this invention is to provide a combination fuel pump and filter assembly.

In accordance with this invention, generally stated, a miniaturized fuel pump is provided in which a two-piece body houses a plunger. The plunger is reciprocated in the body by an intermittently excited coil energized by an

independent microprocessor that derives the signal for energizing the fuel pump from various engine parameters. The body of the fuel pump is intended to permit direct winding of the excitation coil on the body. In the alternative, the excitation coil may be free-wound and later placed on the body in proper relationship to the plunger.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In the drawings, Figure 1 is a sectional view of one embodiment of the present invention.

Figure 2 is an end view of one embodiment of the present invention.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows one illustrative embodiment of a fuel pump A of the present invention. The major components of the fuel pump A are an enclosure 100, a piston assembly 34, a coil assembly 21, and a check valve assembly 22. The enclosure 100 comprises a housing 1, a first housing end cap 2, and a second housing end cap 3. The piston assembly 34 comprises a piston end cap 7, a machine ball 17, and a piston 8 acting together as an inertial check valve. A reset spring 10 and a check valve 22 are include to further coordinate the piston assembly. In this embodiment, the first housing end cap 2 and the second

housing end cap 3 are made from Delrin®, and the housing 1 is made from metal. It will be appreciated, however, that the housings made be made from other materials such as nylon or Teflon®, or the housings may be made from any rigid material provided the materials selected are capable of withstanding the pressures within the fuel pump A and will not deteriorate in the presence of petroleum based fuels. The housing 1, the first housing end cap 2, and the second housing end cap 3 are joined together by any suitable means. Conventional fasteners work well for example. Other fastening methods will be apparent to those skilled in the art.

A filter cap 40 is attached to the first housing end 2 by means of matching threads on the filter cap and the first end housing. A filter 43 is located between the filter cap 40 and the first housing end cap 2 and is held in position by a filter spring 41 located between the filter 43 and the filter cap 40 as the spring 41 presses against a filter end plate 42. An O ring 44 is used between the filter cap 40 and the first end housing 2 to seal the interior of the filter cavity. A threaded opening 45 allows fuel connectors (not shown) to be attached to the filter cap 40.

The first housing end cap 1 is generally cylindrically shaped and includes an annular offset 26 to allow for connection to the housing 1. An annular ridge 27 on the first housing end cap 2 acts as a shoulder to locate the housing 1 onto the first housing end cap 2. A threaded portion 23 on the first housing end cap 2 allows for installation of the fuel pump A onto various types of mounting configurations. A bore 29 and a counter bore 30 provide a channel for fuel flow through the fuel pump A, and the counter bore 30 also acts to help locate and

install the piston end cap 7 and the machine ball 17. A pipe thread 24 is located on the axial centerline of the first housing end cap 2 allows for the installation of various fittings which allow fuel lines (not shown) to be attached to the fuel pump A.

The second housing end cap 3 also includes an annular offset 28 to located the housing 1 onto the second housing end cap 3. A wiring raceway 20 is bored into the second housing end cap 3 to allow a set of conductors 19 of a coil assembly 21 to exit the fuel pump A. In the present embodiment, the set of conductors 19 is connected to a microprocessor (not shown) that provides the intermittent electrical impulses that cycle the fuel pump A and thereby oscillate the piston 8 within the fuel pump A to pump fuel. A second bore 32 and a second counter bore 33 in the second housing end cap 3 allow for fuel flow through the fuel pump A and for the installation of the check valve assembly 22 and the reset spring 10. As with the first housing end cap 2, a pipe thread 25 is located on the axial centerline of the second housing end cap 3 allows for the installation of various fittings which allow fuel lines (not shown) to be attached to the fuel pump A. It understood that when the components of the fuel pump A are assembled, there is an axial opening extending through the fuel pump A.

The coil assembly 21 is positioned between the first housing end cap 2 and the second housing end cap 3. A wire spool 4 of the coil assembly 21 is located within the fuel pump A by a first spacer 5 and a second spacer 6. Each of the spacers 5 and 6 are washers that have axially located openings to allow for the flow of fuel through the fuel pump A. A tube 9 is positioned in axially

alignment with the bore 29 of the first housing end cap 2 and the second bore 32 of the second housing end cap 3, the tube 9 acting as a guide for the piston 8 as it oscillates within the fuel pump A in reaction to the intermittent energizing of the coil assembly 21 by the microprocessor.

In the present embodiment the wire spool 4 is constructed from suitable plastic material. While the present embodiment shows the wire spool 4 constructed in one piece, in other alternative embodiments, the wire spool 4 may be constructed in two parts, with one portion of the wire spool 4 being hat-shaped and the second portion being washer-shaped. In such embodiments, the coil assembly 21 would be assembled by placing a free wound coil onto the hat-shaped portion, the washer-shaped portion thereafter being attached to the hat-shaped portion to create the wire spool 4. In the alternative, the electrical winding may be wound directly onto the wire spool 4.

In the exemplary embodiment shown herein, the fuel pump A is operated using electrical impulse of between about 8 and about 14.5 volts direct current, with a preferred voltage of about 12 volt direct current, and at an RMS current of about 1,000 mA maximum. It will be appreciated that other voltages may be used in other embodiments of the invention. For example six volts direct current can be used when the electrical windings of the coils are manufactured for that voltage. While operating at an oscillating frequency of between about 30 Hz and about 50 Hz, the embodiment shown functions at about a 50% duty cycle. The described embodiment delivers a mass flow rate of about 20 pounds of fuel per hour at a pressure of between about 5 psig and about 15 psig. The present

invention operates in an ambient temperature range of between about 0° C and about 60° C.

The piston end cap 7 is held in place within the counter bore 30 of the first housing end cap 2 by an O ring 18. The machine ball 17 is positioned between the piston end cap 7 and is generally held in position by the piston 8 as the piston 8 is biased against the piston end cap 7 by the reset spring 10.

In operation, when the coil assembly 21 of the fuel pump A is not energized, the reset spring 10 biases the piston 8 against the machine ball 17 and the piston end cap 7. The biased piston 8 presses against the machine ball 17 to seal the machine ball 17 against the piston end cap 7. It is understood that when the fuel pump A is installed into a fuel line of an internal combustion engine, the axial opening through the components of the assembled fuel pump A are filled with fuel.

When the microprocessor energizes the coil assembly 21 by sending an electrical impulse into the set of conductors 19, a solenoid effect is generated that biases the piston 8 away from the piston end cap 7 and toward the check valve assembly 22. The movement of the piston 8 forces fuel through the check valve assembly 22 and through a fuel connector (not shown) that is installed into the pipe threads 25 of the second housing end cap 3. The fuel then continues into the fuel system of the internal combustion engine, eventually entering the cylinders of the engine.

When the microprocessor stops sending an electrical impulse to energized the coil assembly 21, the coil assembly 21 is de-energized and allows the reset

spring 10 to return the piston 8 into its rest position by biasing the piston 8 against the machine ball 17 and the piston end cap 7. As the piston 8 returns to its rest position, the check valve assembly 22 closes to prevent fuel from being pulled back into the fuel pump A by the vacuum created when the piston 8 is biased by the reset spring 10.

It is understood that the coil assembly 21, which operates the piston 8, is activated in a predetermined manner by a microprocessor. Operation of the microprocessor is disclosed in the above referenced U.S. Patent No. 6,343,596, incorporated by reference, and is not described in detail herein.

Numerous variations within the context of the appended claims will be apparent to those skilled in the art. Merely by way of example, and not by limitation, the design silhouette of the enclosure 100 and the first housing end cap 2, the second housing end cap 3, and the housing 1 may vary in other embodiments of the invention. It is noted that these variations are merely illustrative.

While the above description describes various embodiments of the present invention, it will be clear that the present invention may be otherwise easily adapted to fit any configuration where a low cost, microprocessor-controlled fuel pump may be utilized. In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained. As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained

in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim is:

1. A fuel pump for an internal combustion engine comprising:

an enclosure;

a piston assembly;

a fuel filter assembly; and

a coil assembly capable of operating the piston assembly at a frequency of between about 30 Hz and about 50 Hz to generate a fuel pressure of between about 5 psig and about 15 psig at a minimum flow rate of about 20 pounds of fuel per hour when the coil assembly is operated by a microprocessor sending a series of electrical impulses to the coil assembly.

2. The fuel pump of Claim 1 wherein the electrical impulses have a voltage of between about 8 volts direct current and about 14.5 volts direct current at a maximum RMS current of about 1,000 mA.

3. The fuel pump of Claim 2 wherein the fuel pump operates in an ambient temperature of between about 20° F and about 110° F.

4. The fuel pump of claim 3 wherein the enclosure comprises a housing, a first housing end cap, and a second housing end cap.

5. The fuel pump of Claim 4 wherein the piston assembly comprises a piston end cap, a machine ball, and a piston acting together as an inertial check valve.

6. The fuel pump of Claim 5 further comprising a reset spring and a check valve.

7. The fuel filter of Claim 6 wherein the filter assembly comprises a filter cap, a filter spring, a filter, and an O ring, the filter having a filter end plate whereby the filter is held in place by captivating the filter spring between an interior of the filter cap and the surface of the filter end plate.

8. The fuel pump of Claim 7 wherein the piston end cap is held in place within a counter bore of the first housing end cap by an O ring, and the machine ball is positioned between the piston end cap and is generally held in position against the piston end cap by the piston as the piston is biased against the piston end cap by the reset spring.

9. The fuel pump of Claim 8 wherein the first housing end cap is generally cylindrical shaped and includes an annular offset to allow for connection to the housing the annular offset acting as a shoulder to locate the housing onto the first housing end cap.

10. The fuel pump of Claim 9 wherein the first housing end cap further comprises a bore and a counter bore to provide a channel for fuel flow through the fuel pump and wherein the counter bore acts to help locate and install the piston end cap and the machine ball.

11. The fuel pump of Claim 10 wherein the first housing end cap further comprises a pipe thread is located on the axial centerline of the first housing end cap.

12. The fuel pump of Claim 11 wherein the first housing end cap further comprises a threaded portion to allow for mounting the fuel pump.

13. The fuel pump of Claim 12 wherein the second housing end cap further comprises an annular offset to located the housing onto the second housing end cap.

14. The fuel pump of Claim 13 wherein the second housing end cap further comprises a wiring raceway is bored into the second housing end cap to allow a set of conductors a coil assembly to exit the enclosure.

15. The fuel pump of Claim 14 wherein the second housing end cap further comprises a second bore and a second counter bore in the second housing end cap to allow for fuel flow through the fuel pump.

16. The fuel pump of Claim 15 wherein the check valve assembly and reset spring 10 are installed in the second counter bore of the second housing end cap.

17. The fuel pump of Claim 16 wherein the second housing end cap further comprises a pipe thread is located on the axial centerline of the second housing end cap.

18. The fuel pump of Claim 17 wherein the coil assembly includes a wire spool that is positioned between the first housing end cap and the second housing end cap and wherein a spacer is position on each side of the spool .

19. The fuel pump of Claim 18 wherein a tube is positioned in axially alignment with the bore of the first housing end cap and the bore of the second housing end cap, the tube acting as a guide for the piston as the piston oscillates within the fuel pump in reaction to the intermittent energizing of the coil assembly by the microprocessor.

20. The fuel pump of Claim 19 wherein the wire spool is constructed from suitable plastic material

21. The fuel pump of Claim 20 wherein the wire spool is constructed in one piece.

22. The fuel pump of Claim 21 wherein the wire spool is constructed in two parts, with a first portion of the wire spool being hat-shaped and a second portion being washer-shaped.

23. The fuel pump of Claim 22 wherein the coil assembly comprises an electrical winding made from a free wound coil installed onto the hat-shaped portion, the washer-shaped portion thereafter being attached to the hat-shaped portion to create the wire spool.

24. The fuel pump of Claim 23 wherein the electrical winding is wound directly onto the wire spool.

25. A process of manufacturing a fuel pump for an internal combustion engine comprising the steps of:

manufacturing an enclosure;

manufacturing a piston assembly;

manufacturing a filter assembly;

manufacturing a coil assembly capable of operating the piston assembly at a frequency of between about 30 Hz and about 50 Hz to generate a fuel pressure of between about 5 psig and about 15 psig at a minimum flow rate of about 20 pounds of fuel per hour when

the coil assembly is operated by a microprocessor sending a series of electrical impulses to the coil assembly; and

assembling the enclosure, the piston assembly, the filter assembly and the coil assembly to generate fuel pump assembly.

26. The process of Claim 25 further comprising the step of manufacturing the fuel pump to allow the fuel pump to operate in response the series of electrical impulses when said series of electrical impulses have a voltage of between about 8 volts direct current and about 14.5 volts direct current at a maximum RMS current of about 1,000 Ma.

27. The process of Claim 26 wherein the piston assembly comprises a piston end cap, a machine ball, and a piston, acting together as an inertial check valve.

28. The process of Claim 27 further comprising a reset spring and a check valve.

29. The process of Claim 28 wherein the second housing end cap further comprises a wiring raceway is bored into the second housing end cap to allow a set of conductors a coil assembly to exit the enclosure.

30. A fuel pump for an internal combustion engine comprising:

an enclosure;

a filter assembly; and

means for pumping fuel through the enclosure wherein said means includes the ability to operate at a frequency of between about 30 Hz and about 50 Hz to generate a fuel pressure of between about 5

psig and about 15 psig at a minimum flow rate of about 20 pounds of fuel per hour when the coil assembly is operated by a microprocessor sending a series of electrical impulses to the coil assembly, and wherein the electrical impulses have a voltage of between about 8 volts direct current and about 14.5 volts direct current at a maximum RMS current of about 1,000 mA.

SEQUENCE LISTING

None.

ABSTRACT OF THE DISCLOSURE

A fuel pump and filter assembly for an internal combustion engine in which the fuel pump includes an enclosure, a piston assembly, and a coil assembly capable of operating the piston assembly at a frequency of between about 30 Hz and about 50 Hz to generate a fuel pressure of between about 5 psig and about 15 psig at a minimum flow rate of about 20 pounds of fuel per hour when the coil assembly is operated by a microprocessor sending a series of electrical impulses having a voltage of between about 8 volts direct current and about 14.5 volts direct current at a maximum RMS current of about 1,000 mA to the coil assembly.

Sheet 1 of 1 Docket No.: PCRC 8472 UI
Inventor: Seth HARBUCK
Title: Low Cost Fuel P and Filter Assembly
Atty: Douglas E. Warren Ph. 314-872-8118
Express Mail #: EV 255300040US

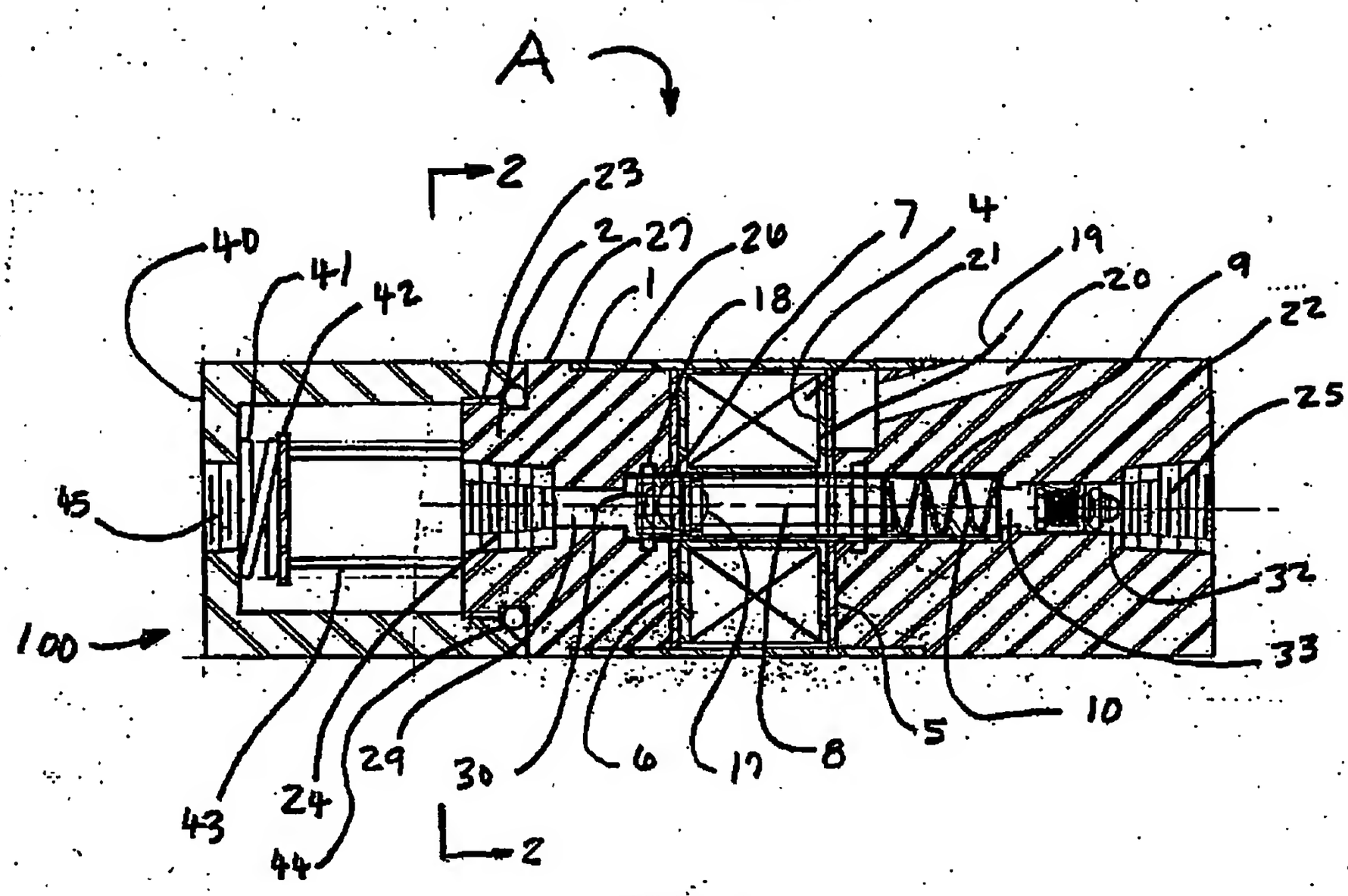

FIG. 1

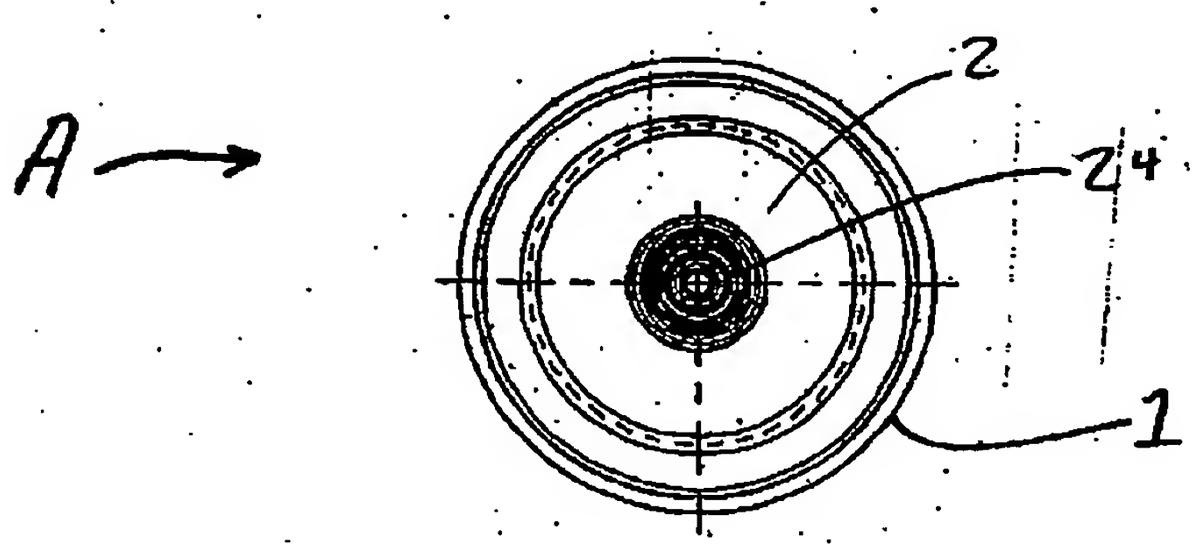

FIG. 2